CRYSTAL FOR A TELEPHONE WATCH

The present invention relates to a crystal for a telephone watch including a keyboard formed in particular of a plurality of capacitive sensors.

A watch crystal under which there is arranged a keyboard formed of a plurality of capacitive sensors has already been proposed on several occasions. European Patent No. EP 0 674 247 will be taken here by way of example. The watch disclosed includes a case, a crystal and at least one manual control device including a capacitive sensor provided with an electrode disposed on the inner face of the crystal. Selective positioning of a finger of the wearer of the watch on the outer face of the crystal allows a capacitance to be formed between the electrode and earth formed by the watch case. This manual control device also includes a voltage-frequency converter whose oscillation frequency is determined by the aforementioned capacitance. The electrode is connected by a conductor to the converter which is housed in the case.

The keyboard in question may be intended to replace the usual external control means such as push-buttons used to control the various functions of a watch, such as time-setting or starting and stopping a chronograph. It will be understood however that this keyboard may also be used as a selector for dialling a telephone number if the watch is provided with a radio telephone.

The telephone watch which will be discussed hereinafter preferably has a case made of plastic material on which a crystal, also made of plastic material, is mounted. This crystal, which is transparent, allows the hour and minute hands to be seen at its centre and the numbers and signs at its periphery, these numbers and signs serving both as time indices and telephone dial numbers. The plastic crystals of currently known watches generally have a sufficient thickness, on the one hand, to resist shocks from external agents and on the other to bear a certain hydrostatic pressure when the watch is immersed in water. The designer has set himself a limit of 3 bars for such pressure here. It will therefore be understood that these constraints mean that a crystal of sufficiently large thickness has to be used which prevents the proper operation of a keyboard placed under the crystal. Indeed, a thick crystal leads to a significant dielectric interposed between the electrodes of the capacitor formed by the sensor and the user's finger. Thus, the capacitance variation may be low, or even insignificant if the dielectric is large.

The object of the present invention is therefore to propose a crystal which resists both shocks and pressure while allowing the capacitive sensor placed under it to operate properly.

The crystal of the invention is thus characterised in that it includes a thick zone and a thinned zone, the keyboard being disposed under the thinned zone.

According to a preferred embodiment of the invention, the thick zone is disposed at the centre of the crystal and the thinned zone at the periphery thereof.

The features and advantages of the invention will now appear from the following description, made with reference to the annexed drawing and giving by way of explanatory but non-limiting example, two advantageous embodiments of the invention, in such drawing:

- Figure 1 is a plane view of the telephone watch carrying a crystal made according to the invention;

- Figure 2 is a partial cross-section of a telephone watch according to a first embodiment of the invention;

- Figure 3 is a partial cross-section of a telephone watch according to a second embodiment of the invention; and

- Figure 4 is a plane view of the capacitive sensors forming the keyboard of the telephone watch.

Figure 1 is a top view of the telephone watch including the crystal according to the invention. This watch includes a case 20 made of plastic material from which two strands 21 and 22 of a wristband start preferably formed in one piece with the case. A bezel 10 is mounted on the case and a crystal 1 is mounted on the bezel. The watch displays the hours and minutes by means of hands 23 and 24. The time shown by the hands is adjusted by a crown 25.

Figure 2 is a cross-section made in Figure 1 and shows a first embodiment of the invention. Crystal 1 includes a keyboard 2 formed in particular of a plurality of capacitive sensor 3 disposed under crystal 1 and which will be described in more detail hereinafter with reference to Figure 4. According to the invention, crystal 1 includes a thick zone 4 at its centre and a thinned zone 5 at its periphery, keyboard 2 being disposed under thinned zone 5.

Thus crystal 1 of the invention is provided with two quite distinct zones. Thick zone 4 is located at the centre of the crystal. This is the zone most exposed to shocks from external agents such as objects encountered when the wearer moves his arm, the edge of a table or a tool for example. This zone may be made to the desired thickness to resist the aforementioned shocks. Thinned zone 5 under which keyboard 2 is disposed is located at the periphery of the crystal where it has been observed that shocks from external agents are less frequent and also less intense. Thus in this zone 5 the thickness of the crystal may be reduced within reasonable limits, one of these limits residing however in the hydrostatic pressure which one wishes the crystal to withstand (the value 3 bars was cited above). As was explained above, the thinning of zone 5 facilitates the proper operation of keyboard 2, since the dielectric interposed

between the operator's finger and the capacitive sensors is reduced, which would not be the case if thinned zone 5 was of the same thickness as thick zone 4.

As is seen in Figure 1, crystal 1 is preferably round, which gives thinned zone 5 a ring shape under which keyboard 2 is arranged.

The way in which keyboard 2 is made will now be specified more precisely. Figures 2 and 3 show that keyboard 2 includes a first decorative layer 6. This decorative layer is opaque in order to prevent any of the layer located underneath it, which will be described hereinafter, from appearing. The decorative layer is further composed of numbers 7 from 1 to 10 (or to zero if preferred) and signs 8, namely a star * and a # sign which all appear through crystal 1 in thinned zone 5. It is clear that these numbers and signs serve both as time markings and as telephone dial numbers. A second layer 9 is disposed under first layer 6. This second layer 9 is formed, as Figure 4 shows, of a plurality of conductive pads 3 (in this case 12 pads). Layers 6 and 9 are oriented and arranged with respect to each other so that there is a conductive pad 3 corresponding to each number 7 or sign 8. As Figure 4 also shows, conductive pads 3 each have a terminal 30 which allows them to be connected individually, via a " Zebra " connector (trademark) to a printed circuit 12 (see Figures 2 and 3).

First and second layers 6 and 9 are disposed one after the other under thinned zone 5 of crystal 1. These depositions are achieved by means known in the art, for example silk screen printing, pad printing or transferring. In order to ensure an easy operation, care will be taken that the bottom face of the thinned zone is free from any asperity or abrupt change of level when one passes from thick zone 4 to thinned zone 5 (see the gradual transition marked by reference 32 in Figures 2 and 3).

The second embodiment of the invention is shown in Figure 3. As is also the case for the first embodiment (Figure 2), Figure 3 shows that crystal 1 is secured onto a bezel 10, the securing being achieved, for example by ultrasound means. Figure 3 also shows that bezel 10 includes an inner reinforcement 11.

This reinforcement 11 extends under thinned zone 5 of crystal 1, in such a way that keyboard 2 is sandwiched between thinned zone 5 and reinforcement 11. The purpose of this reinforcement is to make crystal 1 even more resistant to shocks or pressure.

As a result of this device, one may even further reduce the thickness of thinned zone 5 shown in Figure 3. The thickness of the dielectric is thus reduced at the same time to consequently increase the signal received by conductive pads 3.